2 Collecting and Analyzing Data: Doing and Thinking

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Clinicians embrace problem solving as one of their primary goals in patient care and value this skill as the major determinant of clinical competence. Despite these tenets, there is little conscious utilization of diagnostic reasoning strategies in clinical medicine. The focus is usually placed on pathophysiological knowledge base and not on collecting and analyzing data. When the latter are discussed, it is almost always in reference to algorithms, decision analysis, Bayes's theorem, and the clinicopathological conference exercise.

The physician, as decision maker, must possess a propensity for taking risks, a willingness to be dogmatic at times, and a dogged determination to make adequate decisions based on inadequate information. It is necessary to recognize patterns and to conceptualize, correlate, and compare data analytically. Even the experienced problem solver, however, is limited by cognitive strain. Only a few bits and chunks of data can be processed consciously through operative channels simultaneously. The clinician is limited also by the natural history of the disease. For instance, a symptom or sign may not have been manifested as yet; or certain manifestations may occur only in a small percentage of patients, that is, the sensitivity is low. Finally, the success or failure in the diagnostic process is dependent upon the quality of the patient–physician relationship. The physician must be caring and command sufficient competence in the psychosocial aspects of clinical medicine to facilitate the development of a trusting bond and structure an environment that is conducive to interchange. On the other hand, the patient must be cooperative and capable of relating problems, priorities, and expectations.

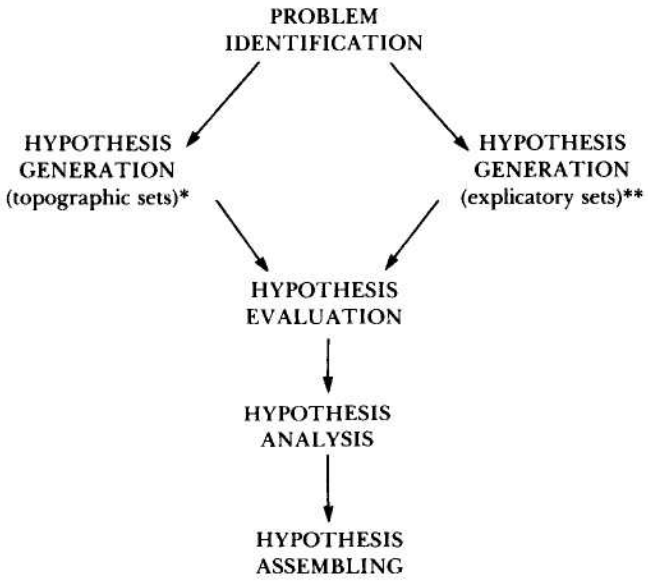
Reduction of cognitive strain is dependent primarily on implementing certain strategies of doing and thinking. Figure 2.1 and Table 2.1 represent a compilation of these general concepts. Whereas it might be assumed that problem solving begins after the pertinent manifestations from the history and physical examination have been gleaned and collated, it actually begins at the moment the patient and physician make initial contact. At this point, the diagnostic possibilities are infinite. The strategies then enable the clinician to sense the existence of a symptom or a sign (problem identification); formulate potential causes (hypothesis generation); collect data methodically (hypothesis evaluation and hypothesis analysis); and finally, to organize, synthesize, and prioritize the significant clinical findings (hypothesis assembling) for subsequent steps in diagnostic reasoning.

This series of methods directs the evaluation and interpretation of disease manifestations and the handling of rival hypotheses and discordant data. They determine the content and sequence of questions posed to the patient, of maneuvers performed during the physical examination, and of laboratory procedures utilized. The physician obviously does not proceed rigidly in the manner outlined. There is constant movement back and forth from one modality to another. The positive outcome of such a process is that the clinician can effectively proceed from infinity, the diagnostic unknown so to speak, to a point quite proximal to the diagnosis utilizing the doing and thinking strategies in the history and physical alone. The diagnosis is reached ultimately, in most circumstances, by implementing the same techniques as they pertain to the laboratory.

It is important to note the differences in doing and thinking when considering the issue of collecting and analyzing data. *Doing* refers to asking questions during the history, performing both general and specific maneuvers in the physical examination, and performing appropriate laboratory procedures. *Thinking* strategies reflect the intellectual tasks required throughout the encounter. The clinician continually generates and reformulates hypotheses, grapples with concepts of choosing appropriate labels or manifestations, and assembles each symptom and sign elicited in the history, physical, and laboratory into problem lists and diagnostic impressions. Thus, thinking forms the basis for all the action-oriented (doing) strategies.

Problem Identification

One cannot solve a problem without first determining that it exists. In the earliest stages of the history, the clinician elicits the chief complaint and other health concerns. This



*Organ, system, channel, region.
**Disorder, derangement, pathoanatomic entity, pathophysiologic entity.

Figure 2.1
Collecting and analyzing data (Adapted from Feinstein, 1973.).

Table 2.1
Collecting and Analyzing Data

Doing	Thinking
Problem identification	
Symptom listing	
Characterization	
Analysis	
	Hypothesis generation
	Topographic sets
	Domain
	Focus
	Explicatory sets
	Disorder
	Derangement
	Pathoanatomic entity
	Pathophysiologic entity
Hypothesis evaluation	
Characterization	
	Hypothesis evaluation
	Choosing manifestations
Hypothesis analysis	
Systems review	
Pathophysiology	
Clinician priority	
Urgency	
Uncertainty	
Threshold	
Reversibility	
Commonness	
Case building	
Elimination	
Discrimination	
Confirmation	
	Hypothesis assembling
	Pertinence
	Clustering
	Splitting
	Problem listing

technique of symptom and problem listing provides the interviewer with diagnostic leads to generate hypotheses and assists in prioritizing the patient's concerns so the problem solver can grasp the big picture and appreciate any potential interrelationship between the various symptoms and problems identified. Another advantage of symptom listing is that it may avoid the dilemma posed by the patient with a positive review of systems.

As symptoms are evaluated and analyzed, other problems are frequently uncovered. Consider a patient who presents with joint pains. During review of this problem, the physician learns that salicylate therapy alleviated the symptoms but was discontinued. Querying the patient discloses that there was an episode of black stools. Thus, the additional problem of melena is identified.

Obviously, there is no correlate of symptom listing in the physical and laboratory areas. However, problems are identified in a fashion similar to the patient with melena above. As an example, a clinician has interviewed a patient with chest pain and has a strong suspicion that it represents angina pectoris. During routine cardiac examination, the patient is found to have a systolic crescendo–decrescendo murmur heard best at the second right intercostal space and radiating to the carotid vessels. Heretofore, aortic stenosis had not been a problem. As for the laboratory, consider a woman who presents with peripheral edema. Neither the history nor the physical examination supports a cardiac, hepatic, venous, or renal cause. Preliminary laboratory investigation includes obtaining a serum albumin level to test the hypothesis of decreased colloid oncotic pressure from liver disease and a urinalysis to confirm or eliminate the possibility of nephrotic syndrome. Both are negative, but the urine does contain moderate amounts of glucose. The possibility of diabetes mellitus now enters this patient's medical profile.

Hypothesis Generation

Formulation and revision of hypotheses are constant features of diagnostic reasoning and pervade the entire encounter (Fig. 2.1). This is somewhat contrary to what is commonly believed, since hypothesis generation is usually ascribed to the history. Hypotheses may be general and refer to topographic parts of the anatomy such as domains (organ, system, region, channel) and foci (a subset of domain). When domains are diseased, certain symptoms and signs emanate. Hypotheses may be specific as well and refer to certain explicatory sets (Table 2.1). These sets may be further categorized into disorders (congestive heart failure), derangements (myocardial infarction), pathoanatomic entities (coronary thrombosis), and pathophysiologic entities (hyperlipoproteinemia). The more specific the symptom or sign elicited, the better chance of activating specific hypotheses. For instance, nausea, inspiratory rales, and an elevated sedimentation rate are nonspecific, whereas syncope, S_3 gallop, and heavy proteinuria are specific. The latter three examples evoke a more narrow differential diagnosis. Some clinical manifestations may even be pathognomonic, that is, only one hypothesis fits. Consider the significance of paroxysmal nocturnal dyspnea, Cheyne-Stokes respirations, an arterial plaque in the fundus, etc. The seasoned practitioner more reliably generates specific hypotheses.

Hypothesis generation is predicated on informed intuition. It is imaginative and to a great extent subconscious. Frequently, armed with the mere knowledge of age, sex, and chief complaint, the clinician can entertain general and specific hypotheses that implicate common, reversible, and even exotic disease states. In fact, early hypothesis generation is the rule. Nevertheless, this is more readily achievable if the case is familiar. Conversely, with an unfamiliar case, effective hypothesis generation is often delayed until a higher percentage of the complete data base is collected. In this latter situation, it is best to concentrate on topographic and not explicatory sets.

Typically only a few hypotheses can be entertained at any time. Clinical findings elicited during the medical interview and physical examination generate the most hypotheses, but positive laboratory data contribute very little to generation of new hypotheses. Usually laboratory procedures are utilized to confirm or reject hypotheses. The number of hypotheses generated depends on the experience of the clinician.

Hypothesis Evaluation

This is the strategy in which the clinician obtains the patient's story and performs the core physical and laboratory examinations in order to clarify and refine hypotheses generated to date. The major elements of hypothesis evaluation

are characterization (doing) and choosing manifestations (thinking). Ultimately, these contribute in a meaningful way to the reformulation of hypotheses for appropriate analysis later. To this point, there has been identification of problems and generation of hypotheses. In order to resolve a problem of unknown cause, as is often the case at the bedside, the physician is confronted with the decision either to search in a nonbiased manner for information through hypothesis evaluation or proceed directly with hypothesis analysis. The option of evaluation grants the potential to convert an open-ended problem into one that is more defined, and in the history dramatically increases the probability of eliciting affirmative responses that are of significantly greater value than when directly testing hypotheses. If one resorts to hypothesis analysis immediately, there is a certain risk to assume. On the one hand, the problem in question may be solved promptly. If the result is negative or not particularly helpful, however, then premature closure is likely and very little has been accomplished.

The following two cases are illustrative: A 72-year-old man presents with progressive dyspnea. No doubt the topographic hypotheses of cardiac and pulmonary causes of dyspnea come to mind immediately. Perhaps such explicatory set hypotheses as chronic obstructive pulmonary disease and congestive heart failure are entertained. Hypothesis evaluation dictates that the physician obtain a clearer picture of dyspnea by determining the circumstances and characteristics of dyspnea (What? How? When? Where?), whereas hypothesis analysis would cause the clinician to query the patient immediately about tobacco usage and a prior history of myocardial infarction, etc.

In the second case, a 47-year-old man consults his physician for anorexia, weight gain, and increased abdominal girth. There is a strong suspicion of heavy alcohol intake. The examining physician may choose to evaluate the patient thoroughly by a careful and methodical examination of all core systems or resort to an hypothesis-driven examination where only the supraclavicular fossae are palpated (neoplastic nodes), the abdomen is inspected for distention (ascites), palpated for masses (hepatosplenomegaly) and fluid wave (ascites), and the skin checked for spider angiomas, the breasts examined for gynecomastia, and the testicles palpated for atrophy. The latter three represent direct testing for potential complications from alcoholism.

Characterization

The hallmarks of characterization are chronology, severity, influential factors, and expert witness. Chronology is applicable to the interview only and is the crux of any present illness. Just as virtually every pathophysiologic process has a beginning, an intermediate stage, and current status, so does each clinical manifestation of disease. Frequently just determining the chronology of a symptom carries clinical significance for diagnostic purposes. Consider the implications of the 45-year-old woman with intermittent disabling headaches for 22 years versus the patient who has suffered similar headaches but only for the last 2 weeks.

Severity is an index of the magnitude, progression, and impact of the disease on the patient's lifestyle. This technique assists the clarification process immeasurably. Reflect on the significance of the following: (1) a patient with extertional and nonexertional chest pain who consumes 5 to 10 sublingual trinitroglycerin tablets per day and is unable to work; (2) a patient with longstanding peptic ulcer disease who presents with an exacerbation and on physical examination is found to have marked epigastric involuntary guarding; and (3) the patient with progressive dyspnea whose pulmonary function testing reveals marked airflow obstruction on all parameters.

Precipitating events, alleviating elements, exacerbating stimuli, and associated symptoms or signs form the components of influential factors. These are well-known aspects of symptom characterization in the present illness but perhaps not appreciated when performing physical examination maneuvers and laboratory procedures. For instance, when examining an elderly woman who injured her hip in a fall, palpation and observation reveal that the pain is partially alleviated with hip flexion, exacerbated with other movements, and that there are associated signs of adductor muscle spasm and external rotation of the hip. As for the laboratory, a 41-year-old man presents with substernal pressure-like chest pain occurring more commonly at rest than after exertion. Both the physical examination and resting electrocardiogram are normal. During a treadmill electrocardiogram, 2 mm of ST depression developed in the inferior leads (precipitated), one episode of six-beat atrial tachycardia was observed (associated), and all changes reverted to baseline 6 minutes after completion of the procedure (alleviated).

The expert witness technique is a method to validate, to collect additional information of diagnostic importance, and to assist in the determination of severity. The physician implements this strategy during the interview with the patient, when communicating with family, friends, ambulance technicians, nurses, etc., and during the physical and laboratory examinations by requesting informal and formal second-opinion consultations from colleagues. There are distinct advantages in the diagnostic and therapeutic framework when a critical finding is confirmed by a trusted associate. Is there asymmetry of the supraclavicular fossae? Is this nevus suspicious for neoplasm? Do you see an infiltrate in the lingula? Are these atypical lymphocytes? As a result of such exchange, clinical certainty is increased and the probability of premature closure is lessened.

Choosing Manifestations

There is a constant interplay between characterization and choosing manifestations. The latter is an intermediate step of hypothesis evaluation in which symptoms, signs, and problems are translated into medically meaningful terms with appropriate pathophysiological significance. Two categories exist under choosing manifestations: labeling and deviance.

Labeling permits the matching of symptoms and signs with accepted medical terminology. Accuracy depends on the clinician's and patient's ability to perceive, interact, and respond to the other individual's verbal comments. When examining the patient, the physician's psychomotor skills, perception, and interpretation of findings are necessary to label correctly. Frequently, when describing or inscribing physical findings, they are not expressed literally and only the interpretative statement is made. The term "spider angiomas" quite adequately and completely accounts for the description: "there are multiple erythematous dot-like lesions with serpiginous processes radiating in several different directions; they blanch on pressure and refill centrally when the pressure is released." The exception is the situation when findings cannot be labeled because the clinician is not knowledgeable enough to do so. In a laboratory study, the process is the same as in the physical examination de-

spite the fact that labeling may be the province of a consultant. As an example, a radiologic procedure would probably be interpreted more expertly by a radiologist. Obviously, there are many pitfalls and errors in labeling because the process is complex, subjective, and dynamic.

The technique of *deviance* applies to understanding the ranges of normalcy and abnormality in assessing the significance of symptoms and signs being evaluated. Discussion of laboratory normal ranges are contained elsewhere in this book. There is considerable difficulty in assigning normalcy and abnormality to clinical manifestations collected during the history and physical. The physician's challenge in the history depends not only on his or her clinical skills, zeal, and biases but also on the patient's level of cooperation and memory. Thus, without attention to details, misperceptions and verbal misstatements occur. Likewise, signs elicited during the physical examination are at best semiquantitative. The danger, of course, is either overinterpretation or underinterpretation of manifestations. The consequences of the former are needless worry, unnecessary investigations, operations, treatments, and excessive costs. In the opposite situation, an underlying disease is not detected.

There is rarely difficulty in determining the abnormal state when marked deviations from normal exist. It is when the manifestation is less than severe that the clinician has a dilemma. It is no wonder that items in the history and physical are reviewed and repeated, that the same laboratory procedure is reordered, and that an advanced level test of a more invasive and costly nature is requested. Furthermore, these situations typically result in soliciting second opinions from other experts.

Hypothesis Analysis

Whether it be soliciting a response during the history, performing a physical examination maneuver, or utilizing a laboratory test, the physician proceeds from an open-ended data collection mode in characterization to direct and specific ones in hypothesis analysis. Implicit in this definition is either a yes–no response in the history or a positive–negative result in the physical and laboratory examinations. Although clinical experience and knowledge of pathophysiology are central to any aspect of the patient–physician encounter, they are infinitely more essential when testing hypotheses. Frequently clinicians may characterize with only topographic-based hypotheses in mind, but it is impossible to analyze without explanatory sets relating to explicit entities, etiologies, and complications at hand. The intellectual preparatory mechanisms embodied in analyzing result in questions, maneuvers, and procedures that reflect more synthesis, development, and creativity. While employing this strategy, the clinician focuses on solidifying or refuting hypotheses entertained. The reward for the yes–no response and the positive–negative result justifies any inherent risk assumed by thwarting spontaneous symptom-related statements from the patient and by sacrificing detailed evaluation of every aspect of the physical and laboratory examinations. The danger of premature closure is no longer a factor.

Pertinent Systems Review

The presence of a symptom, problem, or physical sign, already localized to a domain and focus, requires the search for other symptoms and signs that, if present, may be manifestations of disease in the same domain. This is explorative direct questioning and examining in a nondirective manner. The clinician assumes that pursuing symptoms and signs within the same system is more likely to yield positive results than embarking on a questioning and examining process in an unrelated system area. It also compensates for the physician's fallibility in remembering and recognizing all disease patterns, provides additional thinking time, and permits one to rule out more remote, or even more common, possibilities.

Pathophysiology

This strategy depends on that basic fund of knowledge related to etiologies and complications of disease processes. In this context, as one applies the principles of the history, physical, and laboratory medicine to resolve a patient's problems, the pervasive and primary concern is to affix causality. This is the essence of the physician's expectations as a problem solver. Inherent in utilizing the technique of pathophysiology is that no question, maneuver, or procedure can be effected without a specific hypothetical explicatory set in mind (Figure 2.1, Table 2.1). Searching for etiological clues assists the clinician in isolating the problem according to the pathoanatomic and pathophysiologic entities, whereas seeking complications facilitates focusing on derangements and disorders. Note that the latter two, as explicatory sets, do explain symptoms and signs, but rarely, if ever, account for ultimate causation. For instance, when determining that a patient has paroxysmal nocturnal dyspnea, the theory is that congestive heart failure is responsible for the symptom. As a disorder, however, congestive heart failure is a complication of a more basic disease mechanism, perhaps myocardial infarction secondary to atherosclerosis, which in itself may be caused by acquired hyperlipidemia, etc.

Clinician Priority

This particular subsection of hypothesis analysis addresses techniques that transcend purity in diagnostic reasoning. In all preceding sections the goal was strictly the pursuit of a diagnosis. The concept of clinician priority attempts to focus the diagnostic process into the practical perspective of clinical medicine. These techniques are utilized subconsciously throughout the encounter, but are rarely appreciated as such by the clinician. They represent the "art of medicine" and "picking up the game" strategies that one assimilates, perhaps by osmosis, during clinical training apprenticeships and through continuing professional experience. There are five such categories: urgency, uncertainty, threshold, reversibility, and commonness.

When a clinician acts out of *urgency*, it is because the presence of a particular symptom or sign implies that immediate diagnostic or therapeutic intervention is indicated. It is action oriented. Attention is directed toward the acutely ill and potentially acutely ill, who may have serious life-threatening or fatal diseases. Accordingly, uncommon entities may be ranked higher than those with greater frequency of occurrence. With this in mind, it is easy to comprehend why the physician chooses to elicit the presence of rigors in a patient with fever, dysuria, and flank pain ("Is the patient bacteremic?") and dedicates more than a few moments to observe the same patient carefully for piloerection and decreased skin perfusion. There are even oc-

casions in which the search for a particular complication (hypovolemia from diarrhea) provides a much stronger stimulus for the clinician than the cause of the diarrhea itself.

Coping with *uncertainty* at the bedside is universal. It plagues the physician, but protects the patient. Basically this strategy forces one to collect more historical, physical examination, and laboratory data than may be necessary because the consequences of diagnostic error without doing so are too great. A decision must be made at what level uncertainty is tolerable. The challenge is to be conservative and to avoid errors of omission. It is as if the fear of clinical consequences and its attendant penalties enable clinicians to be more effective. Unfortunately, there is excessive reliance on laboratory medicine. It is infinitely more acceptable to implement the strategy of uncertainty to its fullest during history taking and the physical examination, when patient risk is virtually nonexistent, but it is not necessarily more judicious when utilizing laboratory procedures.

Threshold is the converse of uncertainty. It is that point at which further data could be collected but neither a positive nor a negative response would contribute to the analytic process or change the predictive value significantly. Uncertainty prevails until that critical point when the remaining doubt can be tolerated. The dilemma is whether to continue being driven by uncertainty or to invoke threshold. If the threshold is set too high, then redundant, and often needless, information is sought. When set too low, the physician may negate an opportunity to make a diagnosis or institute therapy.

The emphasis on *reversibility* or treatability embodies the essence of medicine, that is, cure the patient. Relevant data must be collected to aid therapeutic decision making. If presented with two competing hypotheses, the one with the greatest potential for treatment will be ranked higher. The payoff for doing so is greater. The following case exemplifies this: A 59-year-old man has had progressively worsening dyspnea for 2½ years without associated wheezing. Physical examination reveals findings compatible with chronic obstructive pulmonary disease. Pulmonary function spirometry with and without bronchodilators is ordered despite the fact the patient has clinical evidence of irreversible disease. It is hoped that a reactive obstructive component, responsive to bronchodilator therapy, will be uncovered.

The adage "common things are common" aptly describes the technique of *commonness*. Of those techniques discussed previously, it is most likely to be in the clinician's awareness. The issue is one of good sense. It is not helpful to entertain an uncommon hypothesis unless there is good reason, as when invoking urgency and uncertainty. Thus, in the patient with abdominal pain in whom pancreatitis is under consideration, why collect data about symptoms relevant to renal disease, emboli, vasculitis, etc., when it is more appropriate to investigate the presence of symptoms of cholelithiasis and alcohol intake, both of which account for 95% of the cases of acute pancreatitis? Similarly, in a patient with an enlarging abdomen and swollen ankles, it will be a much higher priority to check for signs of cardiac and hepatic diseases as opposed to those implicating inferior vena cava obstruction.

Case Building

This process involves both consolidation of clinical data and refinement and modification of diagnostic possibilities to assist in solidifying hypotheses, refuting them, and distinguishing between two likely candidates. *Elimination* enables one to disprove a hypothesis in a convincing manner by seeking negative responses and results to questions and maneuvers of high sensitivity (true positive rate) for a given hypothesis. Thus it is difficult to entertain seriously the diagnosis of infectious mononucleosis without sore throat, reactive airway disease without prolonged expiration, and nephrotic syndrome in the patient without proteinuria. *Discriminating* between two closely related hypotheses is a frequent challenge. In the patient with several episodes of hematochezia, determining whether the blood is on the outside of the stool or mixed in with the stool helps to distinguish between anal disease and luminal pathology more proximal to the anus. A comparable example in the physical examination is attempting to transilluminate a scrotal mass, and in the laboratory arena when ordering a serum gammaglutamyltransferase in a patient with elevated alkaline phosphatase. Finally, with *confirmation* one attempts to clinch a diagnosis by seeking clinical manifestations of high specificity despite the fact that one or more bits of data already support such. Thus, discerning that a patient has low back pain that radiates to the thigh and lateral calf is suggestive of radiculopathy. But determining that this pain is associated with numbness and that it is exacerbated by coughing, sneezing, and straining is even more convincing. Similarly in the physical examination of a patient with dyspnea on exertion, the findings of peripheral edema, hepatomegaly, inspiratory rales, and distended neck veins support the contention that left-sided heart failure is the cause, but the finding of an S_3 gallop is definitive and confirms the suspicion.

Hypothesis Assembling

This element in the sequential strategic process of diagnostic reasoning encompasses the synthesis and integration of multiple clinical clues from the vast amount of data collected. Assembling is governed by the principle that a hierarchical organizational structure of facts exists in the scheme of diagnosis. The stimuli are to reduce the scope of the problem and sort out the complexities encountered to date. Ultimately, a working problem list will be developed to guide any further investigative pursuits and therapeutic management. To be functional, the problem list must be both coherent and adequate in the context of the patient being evaluated. In history taking, hypothesis assembling encompasses the formulation of a narrowed set of hypotheses to permit further characterization and analysis during the physical examination and laboratory testing. At the conclusion of the physical examination, all clues and elicited manifestations from the history and physical undergo the same process to direct laboratory data collection. Finally, after all appropriate laboratory tests are completed, the problem list is transformed into the refined product of impressions and diagnoses.

Many positive and negative items elicited at the bedside are not relevant and must be filtered out. Pertinence determines which normal and abnormal manifestations will be retained or disregarded and which will require further attention. In general, findings with pathophysiological significance, especially those with a high clinician priority, will be kept. Likewise, symptoms and signs will be retained if there is a potential for inclusion in a particular explicatory set. For example, an 85-year-old man has a 7-day history

of nausea, vomiting (once daily), diarrhea (five to ten times daily), headache, nasal stuffiness, and dizziness. He was treated with antibiotics for a carbuncle 4 weeks ago and has a past history of left inguinal herniorrhaphy and cholecystectomy. On physical examination, he had a 25 mm Hg orthostatic drop in systolic blood pressure, poor skin turgor, scarred tympanic membranes, anisocoria, S_4 gallop, right upper quadrant and left inguinal scars, active bowel sounds, diffuse abdominal tenderness, perianal erythema, perianal skin tag, and a mildly enlarged prostate. Are headache, nasal stuffiness, left inguinal herniorrhaphy, scarred tympanic membranes, anisocoria, etc., pertinent? Are they truly clinical problems worthy of note at this time?

Clustering or lumping is the aggregation of several symptoms and signs into recognizable patterns that fit under the sets of disorders, derangements, pathoanatomic entities, and pathophysiologic entities. They may be related to one another by cause and effect (dependent clustering) or by virtue of their clinical significance (independent clustering). In the former category polyuria, polydipsia, and polyphagia are classic symptoms for diabetes mellitus. The osmotic effect of glucose is responsible for polyuria and calorie loss, which cause both polydipsia and polyphagia. In the independent category, one can cluster orthopnea, paroxysmal nocturnal dyspnea, distended neck veins, positive hepatojugular reflux, S_3 gallop, and peripheral edema under the umbrella of congestive heart failure. Lumping then is consistent with the law of parsimony, which dictates that clinicians should make as few diagnoses as possible. This is monopathic reasoning.

Frequently patients have many positive symptoms and signs. Whereas clustering supports economy in diagnosis, splitting promotes polypathic reasoning with the retention of certain clinical manifestations as separate problem entities because inappropriate aggregation may jeopardize the diagnostic and therapeutic processes. The dilemma posed to physicians by splitting is similar to uncertainty in some respects. There is a fear of missing a diagnosis. In the 85-year-old patient described above under pertinence, orthostatic hypotension was found on physical examination. There is a high probability that this objective sign is caused by vomiting and diarrhea. Thus, they could be lumped together as cause and effect. In so doing, however, the clinician is at risk of excluding a completely separate and important problem, namely, extracellular volume depletion. Splitting prevents this from happening.

Problem listing is the identification of a formalized working set of symptoms and signs, aggregated symptoms and signs, as well as hypothesized derangements and disorders. Either by lumping or splitting, the clinician must account for all positive findings elicited in the history, physical, and laboratory sections of the patient's evaluation. In order to qualify for listing, each must have an importance diagnostically, therapeutically, or both.

Referring once again to the patient described earlier, original laboratory work-up revealed azotemia (blood urea nitrogen, 38 mg/dl; creatinine, 2.4 mg/dl), hypoalbuminemia (albumin, 3.1 g/dl), elevated alkaline phosphatase (alkaline phosphatase, 212 U/L), hyperuricemia (uric acid, 9.2 mg/dl), and moderate stool leukocytes. Thus an appropriate problem list for this patient at the end of the history might include (1) diarrhea, (2) headache, (3) dizziness, and (4) prior surgeries. After the physical examination, the list might be revised to state (1) diarrhea, (2) dizziness, (3) prior surgeries, (4) extracellular volume depletion, (5) perianal erythema, and (6) mildly enlarged prostate. With the knowledge of the laboratory data the refined version might be listed accordingly: (1) inflammatory diarrhea, (2) extracellular volume depletion, (3) dizziness, (4) perianal erythema, (5) mildly enlarged prostate, (6) azotemia, (7) hypoalbuminemia, (8) hyperuricemia, and (9) elevated alkaline phosphatase. Obviously, the patient's problems are not totally resolved, but they are certainly narrowed to the point that focused supportive therapy can be administered and second-line hypothesis-driven laboratory testing can be planned ultimately to confirm definitive diagnoses.

Conclusion

Collecting and analyzing data involve problem identification, generation of general and specific hypotheses, methodical information gathering during evaluation and analysis, and assembling of pertinent clinical clues as problems to direct further investigation and treatment. This process is a continuum and quite dynamic. It never seems to end because the "patient" host and disease are changing variables. The clinician must proceed in a flexible manner throughout the entire framework, based on judgment, learned behavior, and knowledge of pathophysiologic principles.

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